REMARKS

Claims 1-31 are pending in the present application. Claims 1-7, 10-18 and 21-31 are rejected and Claims 8, 9, 19, and 20 are objected to. It is noted that the Information Disclosure Statements filed on 12//2003 and 8/17/2005 have been considered. Further, the drawings received on 4/26/2004 were acceptable.

Specification

The abstract of the disclosure is objected to because it recited phrases that may be implied: "A method is provided..." Correction is required. See MPEP § 608.01(b).

The Abstract is amended herein to remove the objectionable language "A method is provided..."

Claim Rejections - 35 USC § 103

Claims 1-7, 10-18, and 21-31, are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (Applied Physics Letters, Vo. 78, (No. 23), pages 3714-3716) in view of Bower et al. (US 6,630,772 B1).

A. Chen teaches a process for the deposition and alignment of single-walled carbon nanotubes (SWCNT) on a substrate, between opposed electrodes, utilizing AC potential.

B. Chen does not explicitly teach a carbon nanotube (CNT) attraction material.

C. Bower teaches the deposition of CNTs utilizing electric current for alignment, in which a layer of anchoring material is first applied to the substrate (4:10-25).

D. It would have been obvious to one of ordinary skill in the art to modify the process of Chen so as to utilize an anchoring layer, as taught by Bower. One of ordinary skill in the art would have been motivated by the desire and expectation of successfully adhering the CNT to the substrate.

E. Further, in order to assure complete coverage of the substrate with the CNTs, it would have been obvious to one of ordinary skill to utilize a solution containing an excess of CNTs, which would necessarily result in a portion being adhered and a portion not being adhered.

F. Finally, it is the Examiner's position that Chen's "drying in air" reads on the claimed "removing the carrier liquid and said second [non-adhered] portion of said CNTs from said assembly."

G. With specific respect to claims 2-6, 13-17, and 24-28, the limitations of these claims are all expedients that would have been readily obvious to one of ordinary skill in the art for removing excess fluid from the substrate.

H. Further, with specific respect to claims 11, 22, and 31, insofar as the CNTs are dispersed in solution prior to deposition, it is the Examiner's position that the van der Waals forces are minimized.

The Applicants agree that *Chen* teaches a method for aligning single-wall carbon nanotubes with an alternating electric field, but does not teach the use of an attraction material for specific placement of carbon nanotubes in predefined regions on the device substrate. As provided in the present specification and claims:

'[0011] In general, the present invention modifies assembly 10 by (i) specific placement thereon of a material that attracts CNTs thereto, and (ii) deposition and alignment of CNTs on the specifically-placed CNT attraction material ...'

Claim 1: '...providing an assembly that includes a substrate having at least two electrodes supported thereon and opposing one another with a gap region being defined therebetween;

depositing a carbon nanotube (CNT) attraction material on said substrate in said gap region;...'

The Examiner asserts that *Bower* teaches the use of a layer of anchoring material first applied to the substrate. The Applicants respectfully assert that *Bower* teaches the use of a 'surface layer containing carbon-dissolving or carbide forming materials (column 3, line 66 – column 4, line 2; column 4, lines 12-14) or a 'substrate having a low melting point ... such as aluminum' (column 4, lines 14-16). Following deposition of the nanotubes, such materials are heated to induce reaction of the carbon nanotubes with the carbon-dissolving or carbide forming materials or melting of the surface layer to anchor the nanotubes to the surface (column 4, lines 16-19). Further methods using the mixing of preformed nanotubes with solvent and binder, and optionally solder, and depositing the mixture onto a substrate, also require subsequent heating to activate the solder and/or melt the solder (column 4, lines 19-25). These methods for anchoring

nanotubes to the substrate surface are inherently different from the CNT attraction method of the present invention, and are not compatible with the methods taught for nanotube alignment or for the creation of nanotube conducting paths as taught in the present application. The anchoring later taught by *Bower* is inherently different from the CNT attraction method of the present invention. See, for example:

> *'[0003] The present invention is a method for the deposition and alignment ... An electric potential is applied to the two electrodes so that an electric field is generated across the gap region ...'*

> *'[0012] ... If the ultimate application of aligned CNTs is to use the electrodes 20 and 22 along with aligned CNTs in an electrical conduction path, ...'*

Specifically:

1) The anchoring method taught by *Bower* does not attract CNTs, but merely provides a mechanism (subsequent heating) to bind CNTs to the surface on which they are deposited. In contrast, the method of the present invention attracts CNTs out of solution at specific locations on the device substrate.

2) The method taught by *Bower* is incompatible with CNT alignment and creation of conducting networks.

a. The use of a carbon dissolving material forms defects in the carbon nanotubes and thereby destroys or significantly reduces the strength and quantum transport properties found in pristine CNTs. The CNT attraction material of the present invention does not have this effect. As noted in the Detailed Description of the invention,

> *'[0022] ... The method provides for the controlled deposition and alignment of CNTs such that their electrical conductive properties can be exploited.'*

b. The use of a substrate such as aluminum is incompatible with electric field alignment as taught by *Chen*. The electric potential imposed to create the required electric field would instead couple with the conductive substrate such that no significant electric field would exist within the nanotube carrier liquid and no nanotube alignment would occur.

Additionally, the present invention teaches alignment of nanotubes from a carrier liquid (ex situ). The only method of ex situ alignment of nanotubes taught by *Bower* requires the

formation of a nanotube-polymer composite and involves steps such as straining at a temperature above the polymer softening temperature or shear casting (column 8, lines 52- 9:11).

Further, the Applicants respectfully assert that removing the carrier liquid and non-adhered portion of CNTs from assembly is distinct from drying in air. In the latter process, all material in suspension will drop to the substrate surface. The removal process taught by the current invention removes excess solids with the carrier liquid such that such solids (nanotubes and potential contaminants) do not contaminate the substrate surface and leave material in unplanned locations.

The anchoring materials and techniques taught by *Bower* would be understood by one of ordinary skill in the art to be detrimental to the nanotube alignment technique taught by *Chen*. The combination or modification of the references in the manner suggested by the examiner would render *Chen* inoperable for its intended purpose. MPEP §2143.01 states:

> *If [the] proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification.*

Because from the facts derived from the references, as set forth above, the suggested combination or modification would render *Chen* inoperable for its intended purpose, the rejection is unsupported by the art and should be withdrawn.

Based on the above, the Applicants respectfully traverse the Examiner's rejection and respectfully argue that a *prima facie* case of obviousness has not been established.

With regard to the Examiner's comments 'G' and 'H', the Applicants assert that claims 2-6, and 11, which depend from claim 1; claims 13-17, and 22, which depend from claim 12; and claims 24-28, and 31, which depend from claim 23, are allowable in view of the above arguments.

Allowable Subject Matter

Claims 8, 9, 19, and 20, are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 8, 9, 19 and 20 are amended herein to independent form including all of the limitations of the base claim and any intervening claims. The Applicants respectfully assert that claims 8, 9, 19 and 20 are now allowable.

CONCLUSION

Applicants submit that pending claims 1-31 in the instant application are in condition for allowance, and respectfully request an early action to this end.

Respectfully submitted,

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